CORRES. CONTROL OUTGOING LTR. NO.		
DOE ORDER #		
01-RF-02789		
DIST.	LTR	ENC
BRAILSFORD, M.D	X	
BURNS, T.F.		
CARD, R.		
FERRERA, D.W.		
FERRI, M.S.	X	
FULTON, J.C.		
GIACOMINI, J..		
HALL. L		
ISOM, J.H.		
MARTINEZ, L.A.		
MOTES, J.L.		
PARKER, A.	X	
POWERS, K.		
RAAZ, R.D.		
SCOTT, G.K.		
SHELTON, D.C.	X	
SPEARS, M.S.		
TRICE, K.D.		
TUOR, N.R.		
VOORHEIS, G.M.		
BERARDINI, J	X	X
GEIS, A.	X	
RODGERS, A	X	
NORTH, K.	X	
NESTA, S.	X	
GILGREATH. C.	X	
ARNOLD, P.	X	
HOPKINS, T.	X	
CORRES.CONTROL	X	X
ADMIN RECRD/460		
TRAFFIC		
PATS/T130G		
CLASSIFICATION:		
UCNI		
UNCLASSIFIED	X	X
CONFIDENTIAL		
SECRET		

AUTHORIZED CLASSIFIER SIGNATURE:
CEX-105-01
Date: 11/29/01
IN REPLY TO RFP CC NO.:

ACTION ITEM STATUS:
☐ PARTIAL/OPEN
☐ CLOSED

LTR APPROVALS:

ORIG. & TYPIST INITIALS:
JHB : vmb

RF-46469 (Rev. 8/4/95)

KAISER•HILL
COMPANY

November 29, 2001

01-RF-02789

Mr. Fred Dowsett
Colorado Department of Public Health and Environment
Hazardous Materials and Waste Management Division B-2
Compliance Coordinator
4300 Cherry Creek Drive South
Denver, CO 80246-1530

CHARACTERIZATION OF GLOVEBOXES AS NONHAZARDOUS WASTE PER DEBRIS RULE – JHB-014-01

Dear Mr. Dowsett:

I have received your letter dated October 11, 2001, concurring with Kaiser-Hill Company, LLC. (Kaiser-Hill) non-hazardous waste characterization of gloveboxes with leaded windows attached. In the letter, you recite Rocky Flats Environmental Technology Site (Site) needs to receive concurrence from the State of Nevada. We regret that Nevada Test Site (NTS) and Nevada do not concur yet with the arguments that we have been advancing thus far. Nevertheless, NTS has expressed a willingness to continue the discussion about characterization of this waste stream. Thus, an alternative approach is presented for your consideration, below.

It is our hope that you will concur with the assessment that gloveboxes, including windows and gloves, are correctly classified as debris; that this debris is appropriately excluded from Subtitle C regulation because it is no longer contaminated with hazardous constituents at the contained-in level; and, thus, that these leaded components are not hazardous waste and can be disposed as straight low-level waste at the NTS.

Safety Considerations. Significant levels of plutonium contamination (primarily alpha radiation) are known to remain within gloveboxes, even after extensive decontamination efforts. Removal of leaded components from gloveboxes exposes decontamination and decommissioning (D&D) workers directly to these contamination hazards, prolongs exposure to external radiation sources in the work area, and presents serious potential for industrial injury. These potential radiation exposures are especially significant in relation to removal of windows, which cannot be accomplished without a substantial breach of the containment of alpha contamination otherwise provided by the glovebox. These potential exposures to radiation hazards should be avoided in order to keep potential radiation exposures *as low as reasonably achievable ("ALARA")* unless the environmental regulations *require* component removal. Therefore, because of these significant safety considerations, these gloveboxes should not be further dismantled for disposal.

As previously described[1], the glovebox-equivalents are comprised of a stainless steel carcass, lead bearing glass[2] and, potentially, other lead bearing components such as gloves. As noted in many of our

[1] September 25, 2001 Letter from Jacqueline H. Berardini to Mr. Fred Dowsett, 01-RF-02277.

Kaiser-Hill Company, L.L.C.
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Mailing Address: P.O. Box 464, Golden, Colorado 80402-0464

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32

discussions, the leaded components continue to serve their originally intended purpose, namely, containment of radioactive contamination. Thus, they have not been "discarded" and are not solid waste. Alternatively, we provided a description of the Site's process knowledge upon which a non-hazardous waste characterization was based. That analysis did not rely upon a Toxic Characteristic Leaching Procedure (TCLP); Environmental Protection Agency (EPA) has noted that the TCLP is not always suitable or appropriate for evaluating solid wastes. Similarly, the Court of Appeals for the D.C. Circuit determined (in an appeal of a rule making last year) that use of the TCLP is not appropriate when the waste will not be co-disposed with municipal solid waste. *Association of Battery Recyclers, Inc. v. United States EPA,* 208 F.3d 1047 (D.C. Cir. 2000). These lines of reasoning are pertinent to the gloveboxes containing leaded components.

Without conceding these arguments, an alternative regulatory analysis is offered for your consideration, which is based upon a site-specific risk analysis of disposal of debris, namely a glovebox with leaded components, at the NTS.

A glovebox meets the initial definition of "debris", 40 CFR 268.2(g). It is a

> "solid material exceeding a 60 mm particle size that is intended for disposal and ...(is a) manufactured object. However, the following materials are not debris: any material for which a specific treatment standard is provided in Subpart D, Part 268, namely radioactive lead solids. ..."

Neither the stainless steel glovebox carcass nor the lead-impregnated windows are radioactive lead solids. At the time EPA first promulgated a treatment standard for "radioactive lead solids", it clarified the meaning of the term in the preamble to the final rule.

> "(T)oday's treatment standard[3] applies to all forms of radioactive mixed waste containing elemental lead (including discarded equipment containing elemental lead that served a personnel- or equipment- shielding purpose prior to becoming a Resource Conservation and Recovery Act (RCRA) hazardous waste)," 55 FR 22520, 22628 (June 1, 1990).

The definition has been modified slightly, but the essential requirement for "elemental lead" has remained constant:

> "These lead solids include, but are not limited to, all forms of lead shielding *and* other elemental forms of lead," 40 CFR §268.40 Treatment Standards for Hazardous Waste, D008 – Radioactive Lead Solids. (Emphasis added.)

As determined by Dr. Drexler's examination of the glass at issue the form of lead in the windows is not elemental; the formula for the interior glass is most likely $PbSi_2O_5$[4].

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[2] In this case, an inner layer of lead-impregnated glass approximately 1 cm thick, sandwiched between two outer panes of non-lead bearing soda/safety glass (3.0 mm each). These were manufactured as a single piece of glass and are not separable plates.
[3] The 'Radioactive Lead Solids Category' was, at that time, substantially similar to the current regulation.
[4] Laboratory Report, Dr. John W. Drexler, Laboratory for Environmental and Geological Studies, University of Colorado, August 14, 2001, Attachment 1.

2

The conclusion that the glovebox windows are not radioactive lead solids is also consistent with common sense. The windows are approximately 1.5 cm thick, consisting of two outer plates of non-lead bearing soda/safety glass (3.0 mm each) surrounding an inner layer of leaded glass (7.3 mm). These were manufactured as a single piece of glass and are not separable plates. While the exterior surfaces are or may be contaminated with alpha radiation, the interior leaded portion is neither radioactive itself, nor is it contaminated with radioactivity.

The form of lead in the gloves may be elemental but is neither radioactive nor radioactively contaminated, and so the gloves are not "radioactive lead solids". They would, accordingly, be managed under RCRA as debris.

Alternatively, even if gloves were excluded from the definition of "debris" as radioactive lead solids, the debris mixture rule would nevertheless provide for their management as debris. The rule states that:

> "A mixture of debris that has not been treated to the standards provided by § 268.45 and other material is subject to regulation as debris if the mixture is comprised primarily of debris, by volume, based on visual inspection."

A visual examination of gloveboxes will indicate that gloves are only a small component of the structure; the debris, namely the stainless steel carcass and windows, comprise a greater volume than the gloves. Thus, the entire glovebox with windows and gloves intact may be considered debris.

Under the "Contained-In Policy," contaminated debris can be excluded from Subtitle C based upon a case-by-case determination that untreated debris contains hazardous waste at levels at which potential threat to human health and the environment is minimized. Such debris, if found not to pose a risk to human health and the environment, would not require further treatment in order to be land disposed and would not be a hazardous waste. It is important to note that the focus of the contained-in policy is to evaluate risks to human health and the environment, not the regulatory definition of a hazardous waste. Hence, the policy allows the regulatory agency to determine that wastes that are by definition hazardous (e.g., listed wastes) do not warrant further Subtitle C control. In the preamble to the proposed Debris Rule, EPA made clear that it was proposing to allow for a risk–based demonstration to exclude debris from Subtitle C. 57 FR 958, 985-986 (January 9, 1992). The final Debris Rule adopted the proposed approach. See 40 CFR §261.3(f)(2), which reads:

> (2) Debris as defined in part 268 of this chapter that the Regional Administrator, considering the extent of contamination, has determined is no longer contaminated with hazardous waste.

In the Preamble to the Final Rule, EPA reiterated the intent behind this provision, namely that hazardous debris may be excluded from Subtitle C regulation by the agency's determination (or authorized state's determination) that the debris no longer contains hazardous waste, 57 FR 37194, 37239 (August 18, 1992). The site specific risk analysis is intended to determine whether the debris poses a threat to human health and the environment, in consideration of such factors as Site hydrogeology and potential exposure pathways, but excludes management practices[5]. Upon

[5] Consideration of management practices was deferred until amendment of the Hazardous Waste Identification Rule, discussed below.

such a showing, and approval by the regulatory authority, debris found not to "contain" hazardous waste would not be subject to further Subtitle C regulation and could be land disposed without further treatment, id at 37226.

The gloveboxes with leaded glass windows and leaded gloves intact will not cause or present a hazard to human health or the environment. This statement is based upon six factors. First, the structural integrity of the glass is strong; it is a monolith. See report of Structural Integrity Test[6], Attachment 2, Southwest Research Institute, September 4, 2001, which reports that only debris and small pieces of the *exterior* safety glass broke apart from the "monolithic" window. Second, the physical composition of the window is such that the lead may be considered vitrified and macroencapsulated by the exterior unleaded glass portions. Third, the characterization of the leaded glass windows for lead bioaccessibility and bioavailability, as assessed by Dr. John W. Drexler, indicates that lead in this waste form (at particle sizes $\geq$ 1.0 g) would be less bioavailable than lead in mining overburden (slag). (It is interesting to note that slag has been exempted from the definition of hazardous waste by the Bevill Amendment.) See Attachment 1 for greater detail about the physical composition of the window, its low potential for leaching and the low relative bioavailability of lead in this form.

Fourth, it is anticipated that the gloveboxes will be packaged for disposal in cargo containers. This will provide yet another measure of minimizing risk by isolating lead from environmental receptors.

Fifth, the hydrogeology of the proposed disposal site, NTS, is such that leaching lead from the glovebox windows and gloves is highly unlikely. See [Hydrogeology and Potential Exposure Pathways for Lead in Glovebox Windows and Gloves], Attachment 3.

Finally, it is noted that the windows, as well as the gloves, were originally manufactured in a way that encapsulates the lead[7]. The Land Disposal Restrictions (LDR) Debris treatment standard for lead is immobilization, which technology includes macroencapsulation, 40 CFR §268.45. Even if these leaded components were considered hazardous waste (which characterization we dispute), the regulators must acknowledge that their disposal does not pose a significant threat to human health or the environment since the leaded components meet the Debris Treatment Standard.

Thus on the basis of these six reasons, it is concluded that disposal of gloveboxes with leaded glass windows and leaded gloves intact do not present a significant potential threat to human health nor the environment. As such, these gloveboxes can, therefore, be excluded from Subtitle C management in accordance with 40 CFR §261.3(f)(2) which was adopted and incorporated by reference by Nevada, NAC 444.8632 (1); and which was adopted by Colorado, 6 CCR 1007-3 §261.3 (f)(2).

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[6] The EP Toxicity Test provided a method to determine sample sizes for "monolithic wastes". It required leaching pieces of the "monolith" that were broken away in the course of a Structural Integrity Test. Although the Structural Integrity Test is not specifically authorized by current regulation, it provides an objective basis for evaluating the structural strength of the GB windows.

[7] The lead is homogeneously distributed in the inner glass plate and is further encapsulated by two outer plates of non-leaded glass. And, EPA has considered leaded gloves to be macroencapsulated. See EPA's letter to the Environmental Policy Center dated December 27, 1990 (OSWER 9554.1990(14)) determining that plastic coated, lead lined gloves comply with the standard identified as "MACRO" provided that none of the lead is exposed and that the coating provides a substantial reduction in surface exposure to potential leaching media.

4

As a corollary, it is noted that EPA has made a similar determination in the context of its amendment of the Hazardous Waste Identification Rule. It was determined that low level mixed waste that is disposed in facilities licensed by the Nuclear Regulatory Commission (NRC) or NRC-agreement states can be managed as solely radioactive waste. This conditional exclusion from Subtitle C regulation was written in specific contemplation of the NRC system for disposal of radioactive wastes including the licensing requirements, disposal practices and requirements, and compliance history. EPA concluded that

> "LLMW ..., disposed of at these facilities, are not likely to pose a threat to human health and the environment. Therefore, RCRA Subtitle C regulation for these wastes is not necessary to ensure protection of human health and the environment," 66 FR 27218, 27224 (May 16, 2001).

Although NTS is not a disposal site licensed by the NRC or an NRC-agreement state, it is nevertheless a rigorous facility, subject to many of the same requirements for the safe disposal of radioactive wastes. These include requirements relating to radioactive waste management; conduct of operations; emergency management; environmental reporting and monitoring; hazard analysis; packaging and transportation; quality assurance; radiation protection; site evaluation and facility design; training and qualifications; waste minimization and pollution prevention; and, worker protection. See DOE Order 435.1 and Implementation Guide DOE M 435.1-1. From a risk perspective, it is not necessary to add an additional overlay of Subtitle C regulation for human health or environmental protection in the disposal of the debris described in this paper

Your review and concurrence is requested with the assessment that gloveboxes, including windows and gloves, are debris; that this debris is appropriately excluded from Subtitle C regulation because it meets the criteria for exclusion under the "Contained-in Policy" as codified at 40 CFR § 261.3 (f)(2); and, therefore, that these leaded components are not hazardous waste and can be disposed as straight low-level waste at the NTS.

If you would like to discuss this analysis, or if you require additional information, please feel free to call me at (303) 966-2058.

Sincerely,

J. A. Geis for

Jacqueline H. Berardini
Material Stewardship
Environmental Manager
Kaiser-Hill Company, LLC

JHB:vmb

Attachments:
As Stated

cc:
James Hindman - CDPHE
Joe Legare - DOE-RFFO

5

LABORATORY REPORT

Characterization of a Multi-Layer Glass Plate for Lead Bioaccessability and Bioavailability

For

Kaiser Hill Company

August 14, 2001

By

Dr. John W. Drexler
Laboratory for Environmental and Geological Studies
University of Colorado
Boulder, CO. 80309
(303) 492-5251

6

EXECUTIVE SUMMARY

The 1.5 cm thick glass plate consists of two outer plates of non lead-bearing soda glass surrounding an inner plate of leaded (~61 wt% Pb) glass. The lead is uniformly distributed within the vitrified material. Intact the plates, which compose the windows (whose edges are sealed by rubber gaskets) of several glove boxes, have a relative bioavailability for lead of less than 1%. Further, in this physical state they would have a very limited impact on groundwater systems. It is my opinion that the plates surface area size and physical structure make significant leaching of lead highly unlikely in a disposal environment.

INTRODUCTION

A sample of a multi-layered glass plate, used in glove boxes at the Rocky Flats Environmental Technology Site, was delivered to the laboratory for lead speciation and invitro bioavailability.
s/b 7.3 mm
The plated glass is composed of a 73mm layer thick leaded glass bonded between two 30 mm thick layers of lead-free glass, Figure
s/b 3.0 mm

1. A representative split of each layer was collected for the invitro bioassay and a polished cross section was prepared for EMPA analyses.

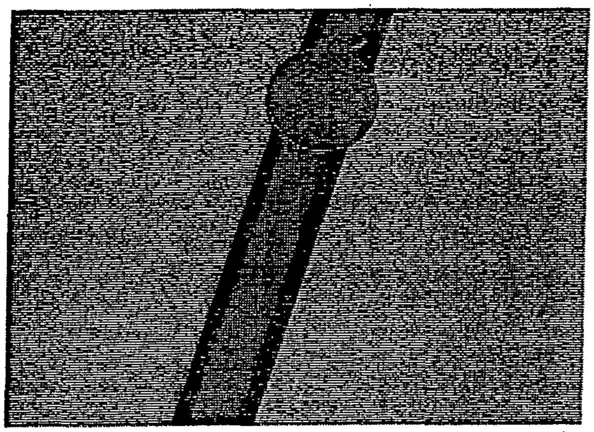

Figure 1. Cross section of multi-layer glass plate. The two dark-green outer plates are lead free and the inner (light green) plate contains approximately 61 wt% lead.

METHODS

Speciation

Lead speciation was conducted on a JOEL 8600 electron microprobe (EMPA) at the Laboratory for Geological Studies at the University of Colorado following the laboratory's SOP. Representative backscatter photomicrographs (BSPM) and x-ray "dot maps" illustrating sample characteristics were acquired. Major elemental analyses were conducted following standard EMPA techniques using certified standards. Accuracy is evaluated on counting statistics and standard reproducibility and reported as minimum detection limits (MDL), Tables 1 and 2.

INVITRO PROCEDURE

Evaluation of bioavailabilty, visa vi gastrointestinal adsorption, was conducted using the method developed at the University of Colorado, Boulder and calibrated to EPA's Region VIII Swine Model Drexler, 1997, Drexler, 1998, and Drexler et.al., 2002. The method has a high level of correlation to the Swine Model for lead (r=0.96).

The method follows a carefully designed laboratory SOP, which is available on request. The procedure uses 1.0 grams of the <250μm size fraction. This material is placed in 125ml wide-mouth HDPE bottles along with 100ml of 1.5 pH extraction solution. The mixture is rotated end-on-end at 37°C in a water bath for one hour. After one hour 10ml of sample is removed, filtered (0.45μm), and analyzed for lead following Method 6010B. Results from this extraction procedure are then used to calculate bioavailable lead from the bulk <250μm concentrations. Quality assurance for the invitro bioavailability procedure consists of:

Regent Blank 1:10
Bottle Spike 1:20
Blank Spike 1:20
Duplicate Sample 1:10
Matrix Spikes 1:10
LCS 1:20

Control limits and corrective actions are described in the QAPP.

DISCUSSION

Physical Form

Speciation of the lead form using EMPA revealed that the lead is homogeneously distributed within the glass structure, as is supported by a backscatter photomicrograph, and x-ray "dot map" distributions of the same section, Figure 2 A and B, respectively. As a waste one could consider it to be vitrified. The leaded glass's bulk composition, Table 1, indicates it contains approximately 66 weight percent PbO, with additional SiO_2 (31%) and BaO (4%). **(NOTE: The lead in the glass does not occur chemically as lead oxide (PbO) but is found as Pb^{+2} ions acting as network modifying cations filling the large holes between each Si/O tetrahedron. The chemical formula for the glass is most likely $PbSi_2O_5$.)** Unlike slag (a waste-glass from smelting) this inner glass

A. B.

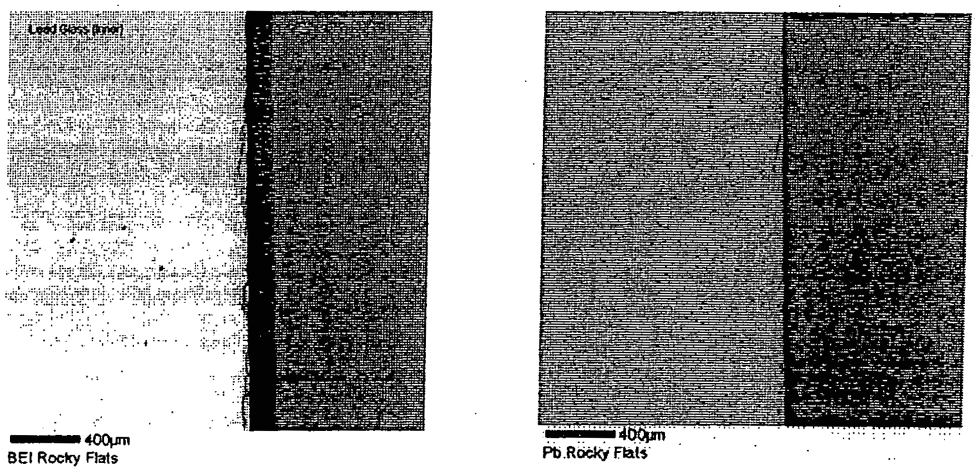

Figure 2. A) Backscatter photomicrograph of both the inner (leaded) and outer (lead-free) glass. B) X-ray "dot map" showing lead distribution in two glasses.

contains **NO** isolated forms of lead oxide, carbonate, or sulfide which can often increase their lead bioavailability. The lead atoms of this inner glass are forming links between silicon and oxygen tetrahedra, as depicted in Figure 3. Therefore lead migration (diffusion) will primarily be dependent on hydrogen diffusion into the glass structure. Glasses of this type are generally very resistant to leaching by water, less than 2% solubility (Haghjoo and McCauley, 1983), but can be readily attacked by acid media.

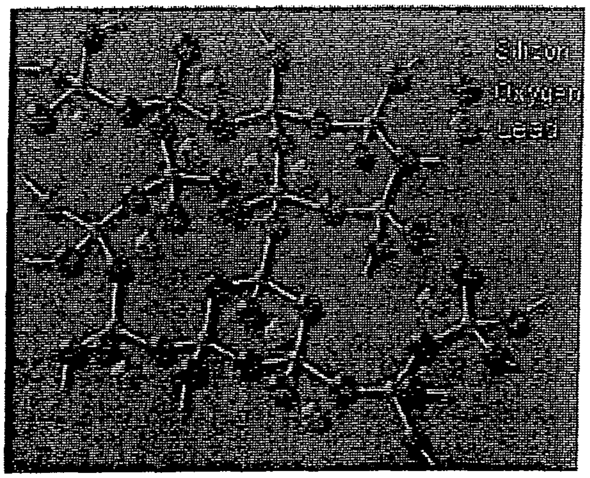

Figure 3. Schematic of leaded glass structure illustrating the lack of symmetry to the structure and the tetrahedral bonding. (Note the lead atoms would be significantly larger than those depicted in this figure).

Bioavailability

The outer glass has a bulk composition, Table 2, similar to most standard soda glasses. By definition, the bioavailable particle-size fraction of a waste is the <250 micron fraction. Therefore by definition, the intact plated glass would **not be bioavailable.** However, for this study, the bioassay was run on three separate sample splits formed by drastically reducing its particle size. The first two splits (one each of the outer and inner glasses) were ground to produce a particle-size fraction <250 microns (0.25mm). The third was a coarse split of the inner glass with particle size of > 1.0 cm. One should interpret these results as worst case. Bioavailability results listed in Table 3 indicate the inner (leaded) glass (at < 250 micron particle-size) has a 30% relative bioavailability (RBA), note that this is not significantly greater than that for the outer (standard, soda-glass, 20% RBA). As expected the RBA for the coarse split of the inner glass was significantly reduced to 0.2%.

For comparison, these results have been overlain on to the invivo results from the EPA Region VIII swine study, Figure 4. The Flats glass (at < 250 microns) would be considered to have low lead bioavailability, lying significantly below the EPA default of 60%

used in the IUBK model. (The fact that the glass is below the IUBK model default is only pointed out to illustrate its low bioavailability compared to many contaminated materials and that one could lower the models RBA factor, thus predicting lower blood leads in a given population.) At a particle size of 1.0 cm, the bioavailability is near zero.

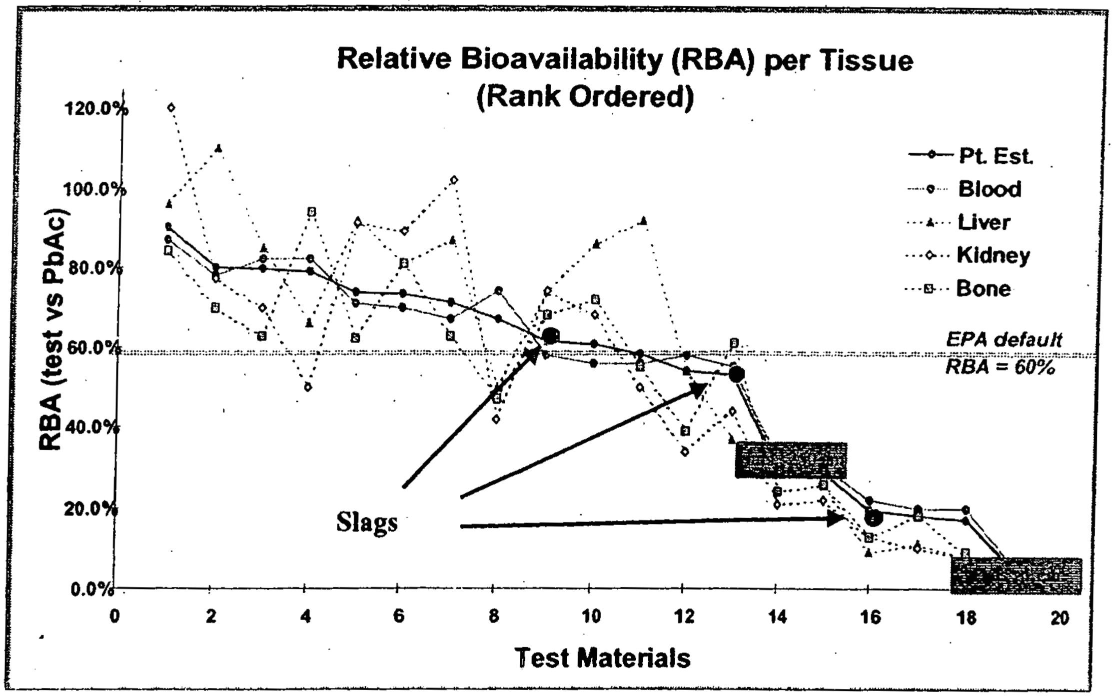

Figure 4. Comparison of Flats glass to other waste materials used in EPA Region VIII swine model.

References

Drexler, J.W., C. Weis, W. Brattin, M. V. Ruby, M. Goldade R. Schoof, G. Henningsen, and S. Christensen, 2002, Relative Bioavailability of Lead: A Validated In-Vitro Procedure, Submitted, Jour. Tox.

Drexler, J.W., 1997, Validation of an In Vitro Method: A tandem Approach to Estimating the Bioavailability of Lead and Arsenic to Humans, IBC Conference on Bioavailability, Scottsdale, Az.

Drexler, J.W., 1998, An In Vitro Method that works! A Simple, Rapid and Accurate Method for Determination of Lead Bioavailability. EPA Workshop, Durham, NC.

Manizhen H., and McCauley, R., 1983, Solubility of lead from ternary and quaternary silicate phases, Am Cer Soc Bull, V 62, 1256-1258.

Table 1. EMPA analyses of Inner glass.

		Oxide Wt%								
Pt#	**BaO**	**PbO#**	**TiO2***	**K2O**	**SiO2**	**Na2O**	**MgO***	**Al2O3**	**CaO***	**Total**
1	4.05	66.03	0.00	0.61	30.47	0.01	0.00	0.05	0.00	101.22
2	4.17	66.41	0.00	0.61	30.53	0.03	0.00	0.05	0.00	101.80
3	4.11	65.65	0.00	0.62	30.81	0.04	0.00	0.07	0.02	101.32
4	4.26	66.22	0.00	0.62	30.75	0.05	0.00	0.06	0.01	101.96
5	4.18	66.54	0.07	0.59	30.90	0.00	0.00	0.05	0.00	102.34
6	4.28	66.44	0.00	0.61	31.18	0.04	0.00	0.06	0.00	102.61
7	4.19	65.16	0.08	0.59	30.77	0.04	0.00	0.06	0.01	100.88
8	4.47	66.95	0.04	0.57	30.69	0.01	0.00	0.05	0.01	102.80
9	4.36	66.04	0.00	0.57	30.56	0.05	0.00	0.06	0.01	101.64
10	4.37	65.96	0.00	0.60	30.67	0.02	0.00	0.04	0.00	101.65
Average	4.24	66.14	0.02	0.60	30.73	0.03	0.00	0.06	0.01	101.82
St.Dev	0.1291	0.4989	0.0316	0.0185	0.2059	0.0177	0.0000	0.0080	0.0070	0.6173
MDL	0.1	0.17	0.12	0.02	0.05	0.00	0.02	0.02	0.03	

* Values below MDL. Results of ICP/MS analyses indicate 274, 18,303, and 44,510 mg/kg respectively

Note: The lead in the glass does not occur chemically al lead oxide (PbO), but is found as Pb+2 ions acting as network modifying cations filling large holes between each Si/O tetrahedron.

Table 2. EMPA analyses of Outer glass.

					Oxide Wt%						
Pt#	**BaO****	**PbO**,#**	**TiO2****	**K2O**	**SiO2**	**Na2O**	**MgO**	**Al2O3**	**CaO**	**Total**	**B2O3***
1	0.00	0.04	0.02	0.11	74.35	6.78	3.89	0.71	8.19	94.09	4.91
2	0.00	0.04	0.09	0.19	75.15	6.80	3.85	0.73	8.20	95.04	3.96
3	0.00	0.03	0.08	0.10	74.13	6.72	3.95	0.73	8.21	93.96	5.04
4	0.08	0.06	0.01	0.19	74.99	6.76	3.95	0.72	8.25	95.01	3.99
5	0.00	0.08	0.00	0.11	75.16	6.75	3.97	0.73	8.22	95.02	3.98
6	0.05	0.00	0.08	0.22	75.62	6.83	3.88	0.70	8.17	95.55	3.45
7	0.02	0.02	0.06	0.09	75.12	6.78	3.81	0.74	8.21	94.86	4.14
8	0.00	0.01	0.21	0.20	75.36	6.93	3.95	0.71	8.18	95.55	3.45
9	0.04	0.00	0.07	0.12	75.63	7.07	3.94	0.70	8.24	95.82	3.18
10	0.05	0.02	0.07	0.19	75.57	6.98	4.03	0.68	8.24	95.82	3.18
11	0.00	0.07	0.11	0.20	74.90	6.63	3.90	0.70	8.22	94.73	4.27
Average	0.02	0.03	0.07	0.16	75.09	6.82	3.92	0.71	8.21	95.04	3.96
St.Dev	0.0292	0.0267	0.0568	0.0488	0.4899	0.1259	0.0613	0.0175	0.0256	0.6296	0.6296
MDL	0.1	0.17	0.12	0.02	0.05	0.00	0.02	0.02	0.03		

*Boron determined by difference

** Values below MDL. Results of ICP/MS analyses indicate 35,590, 70, and 34 mg/kg respectively

Note: The lead in the glass does not occur chemically al lead oxide (PbO), but is found as Pb+2 ions acting as network modifying cations filling large holes between each Si/O tetrahedron.

Table 3. Invitro Relative Bioavailability Results.

Kaiser Hill/Rocky Flats Leaded Glass

Rocky Flats	Lab #	Pb in bulk soil (mg/kg)	mass soil (g)	calc Pb #1	ICP/MS Pb (mg/l)	solution amt (l)	Pb% RBA
Outer Glass	1	70	1.002	0.07	0.144	0.1	**20.5**
Inner Glass (<250 microns)	2	615000	1.002	616.23	1879.000	0.1	**30.5**
Coarse Inner Glass(>1.0 cm)	3	615000	1.110	682.54	14.500	0.1	**0.2**

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Chemistry and Chemical Engineering Division
Department of Analytical and Environmental Chemistry

September 4, 2001

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Mr. Pat Preese

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Arvada, CO 80007

Subject:	Narrative	
	RIN:	01C0207
	Purchase Order:	DAD01ANA
	SDG Number:	166635
	SwRI Project Number:	01.04756.01.006
	SwRI Work Order Number:	20806
	Samples Received:	August 23, 2001

Dear Mr. Preese,

Enclosed please find the analytical data for the above referenced project.

If you should have any questions, please do not hesitate to call me at (210) 522-2356.

Sincerely,

Mike Dammann
Manager

APPROVED:

R. Karimi

Reza Karimi, Ph.D.
Director

MD:mar

SAMPLE DATA PACKAGE COVER PAGE

1. Laboratory Name: Southwest Research Institute
2. Laboratory Code: SwRI
3. Report Identification Number: 01C0207
4. Laboratory Report Identification: #001
5. Line Item Codes: TR01A251
6. Site Sample Numbers:

SwRI ID	Customer ID	SwRI ID	Customer ID
166635	01C0207-1	166636	01C0207-2

7. Sample Matrix: Solid

SOUTHWEST RESEARCH INSTITUTE
CLIENT: KAISER HILL
WORK ORDER: 20806
SDG: 166635(01C0207-1)
VTSR: AUGUST 23, 2001
PROJECT#: 01.04756.01.006

NARRATIVE

CLIENT:KAISER HILL
PROJECT NO. 04756.01.006
SDG: 166635
PAGE 1

1. Two (2) solid samples were submitted for Metals analysis:

SwRI ID	Customer ID	SwRI ID	Customer ID
166635	01C0207-1	166636	01C0207-2

2. Samples were received at SwRI on August 23, 2001, for a fourteen (14) day hardcopy turnaround time from Validated Time of Sample Receipt (VTSR).

METALS ANALYSIS

Testing of samples was done in accordance of 1310A section 7.10 Structural Integrity Procedure.

The test apparatus used was identical with the method except that the bottom holder was modified for the length and shape of the test specimens. The elastimeric material was also not placed all the way to the top of the specimen (see attached photos and table) to allow the hammer full access to the top of the glass.

"I certify that this data package is in compliance with the terms and conditions of the contract, both technically and for completeness, for other than the conditions detailed above. Release of the data contained in this hardcopy data package has been authorized by the Director or his designee, as verified by the following signature. This report shall not be reproduced except in full, without the written approval of SwRI."

J. Ann Boyd

Jo Ann Boyd,
Manager, Quality Assurance Unit

9/04/01
Date

SOUTHWEST RESEARCH INSTITUTE
CLIENT: KAISER HILL
WORK ORDER: 20806
SDG: 166635(01C0207-1)
VTSR: AUGUST 23, 2001
PROJECT#: 01.04756.01.006

CHAIN OF CUSTODY

Enabling Technology, Inc

RFETS

CHAIN OF CUSTODY/SAMPLE ANALYSIS REQUEST

C.O.C. # 01C0207#001

Sampler(s) Conrad Trice (time/date)	Contact/Requester TRICE, CONRAD/BOB CATHEL	Telephone No. 2490/6880
RIN 01C0207	Sampling Origin B776/777	Purchase Order/Charge Code DAD01ANA
Project Title B776/777 LEADED GLASS BLOCKS	Logbook No. N/A	Ice Chest No. N/A Temp.
To (Lab) Southwest Research	Method of Shipment ~~Hand Carry~~ Fed EX	Bill of Lading/Air Bill No.
Protocol	Related COC (if any)	PRE ~~N/A~~ 010822-T130C-003

POSSIBLE SAMPLE HAZARDS/REMARKS
Are acid preserved samples DOT hazardous per 40 CFR Part 136.3 Table II? YES or NO
Are other known hazardous substances present? YES or NO
** ** **

SCREENING REQUIRED ☐

SPECIAL INSTRUCTIONS **Hold Time**
NOTE: CUT THE LARGER PIECE OF GLASS THE SAME LENGTH AS THE SMALLER PIECE OF GLASS PRIOR TO RUNNING TEST.

Bottle No.	Customer Number	Matrix	Date	Time	Location	Container (size/type/quantity)	Sample Analysis	Preservative ; Packing
01C0207-001.001	1	SOLID	8/22/01	11:00	B776/777	1-SAMPLE / N/A /1	TR01A251 (Leaded Glass Structural Integrity Test) [Rush]	None None
01C0207-002.001	2	SOLID	↓	↓	B776/777	1-SAMPLE / N/A /1	TR01A251 (Leaded Glass Structural Integrity Test) [Rush]	None None

JRC 8/22/01

Relinquished By:	Date/Time	Received By:	Date/Time	Relinquished By:	Date/Time	Received By:	Date/Time
Conrad Trice	8/22/01 11:50	JR Christman	8/22/01 1150	JR Christman	8/22/01 1500	Fed EX	
						Joe Maurit	8/23/01 - 09:10

FINAL SAMPLE DISPOSITION	Disposal Method (e.g., returned to customer, disposed of per lab procedure, used in analytical process)	Disposed By	Date/Time

000002

24

SAMPLE LOG-IN SHEET

000003

Lab Name: Southwest Research Institute	Page 1 of 1
Received By (Print Name): Joe Morin JR.	Log-in Date: 08/23/2001
Received By (Signature): Joe Morin	
Case Number: 01C0207	Sample Delivery Group No.: 166635	SAS Number: N/A

Remarks: 04756.01.006

1. Custody Seal(s) — Present/Absent* ; Intact/Broken
2. Custody Seal Nos. — N/A
3. Chain-of Custody Records — Present/Absent*
4. Traffic Reports or Packing Lists — Present/Absent
5. Airbill — Airbill/Sticker Present/Absent*
6. Airbill No. — 453321277660
7. Sample Tags — Present/Absent
   Sample Tag Numbers — Listed/Not listed on Chain of Custody
8. Sample Condition — Intact/Broken*/Leaking
9. Cooler Temperature — 22C
10. Does Information on custody records, traffic reports, and sample tags agree? — Yes/No*
11. Date Received at Lab — 08/23/2001
12. Time Received — 09:10:00

EPA Sample #	Corresponding Sample Tag #	Corresponding Assigned Lab #	Remarks: Condition of Sample Shipment, etc
01C0207-1	NONE	166635	INTACT
01C0207-2	NONE	166636	INTACT

Sample Transfer

Fraction: See ATTAched	Fraction:
Area #: INORG-1	Area #:
By: jmk	By: jmk 8/23/01
On: 8/23/01	On:

* Contact SMO and attach record of resolution

Reviewed By: jmk	Logbook No.: Work Order (20806)
Date: 8/23/01 - 13:05	Logbook Page No.: 4077 (section 2012)

FORM DC-1

OLM04.2

25

SOUTHWEST RESEARCH INSTITUTE
CLIENT: KAISER HILL
WORK ORDER: 20806
SDG: 166635(01C0207-1)
VTSR: AUGUST 23, 2001
PROJECT#: 01.04756.01.006

METALS ANALYSIS

26

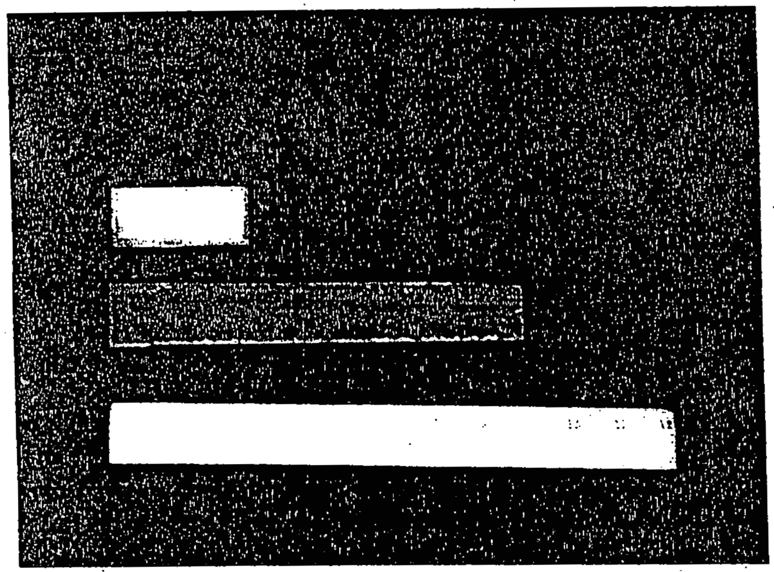

Figure 1 - A picture of both samples, Client ID: 01C0207-1 (short), 01C0207-2 (long) prior to testing "as received"

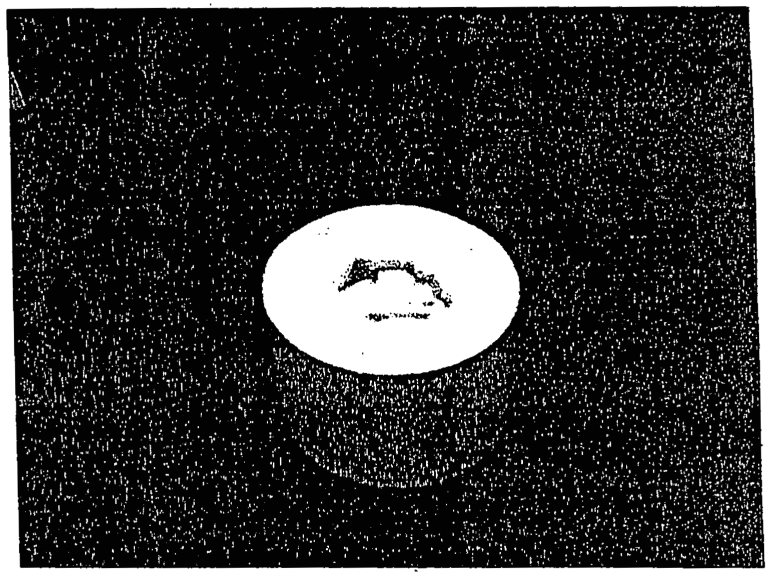

Figure 2- A picture of the short sample, SwRI Lab ID 166635, in the bottom portion of the test jig.

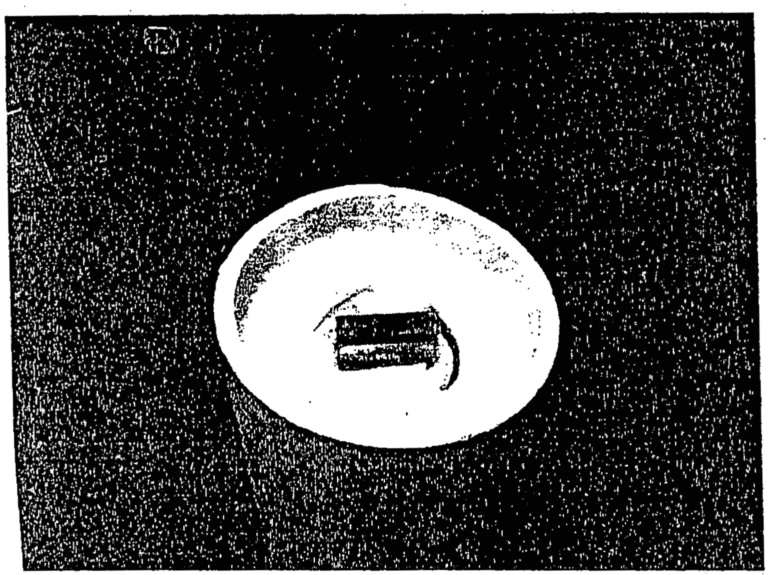

Figure 3 - A picture of the long sample, SwRI Lab ID 166636, in the bottom portion of the test jig.

Figure 4 - A picture of the short sample after testing and the associated loose material generated during the test.

010001

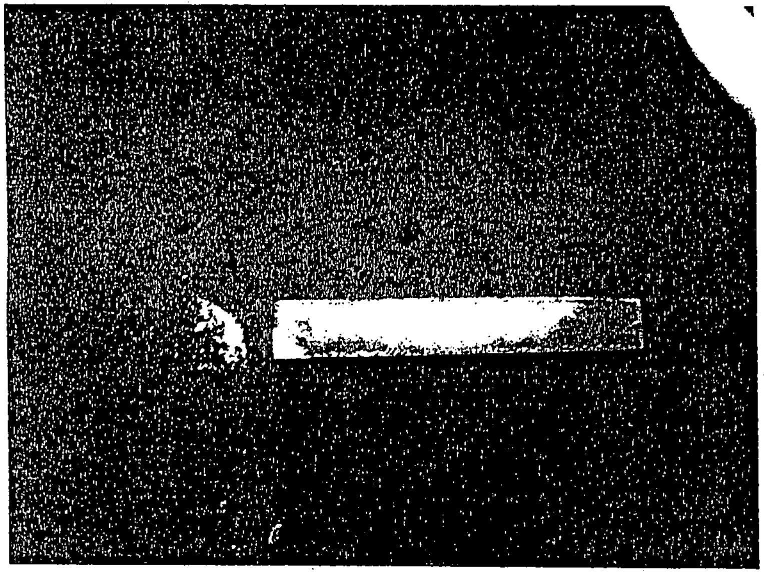

Figure 5 - A picture of the long sample after testing and the associated loose material generated during the test.

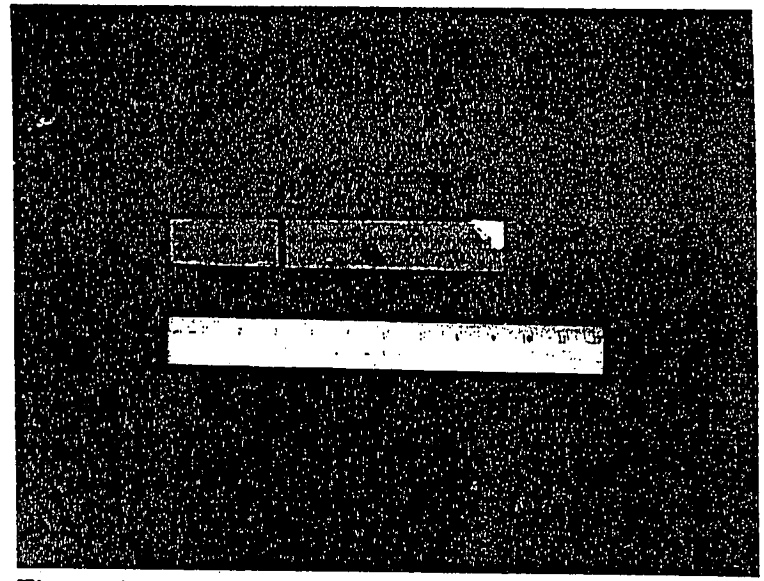

Figure 6 - A picture of the long sample after being cut into two pieces, the shorter one the same length as the short sample.

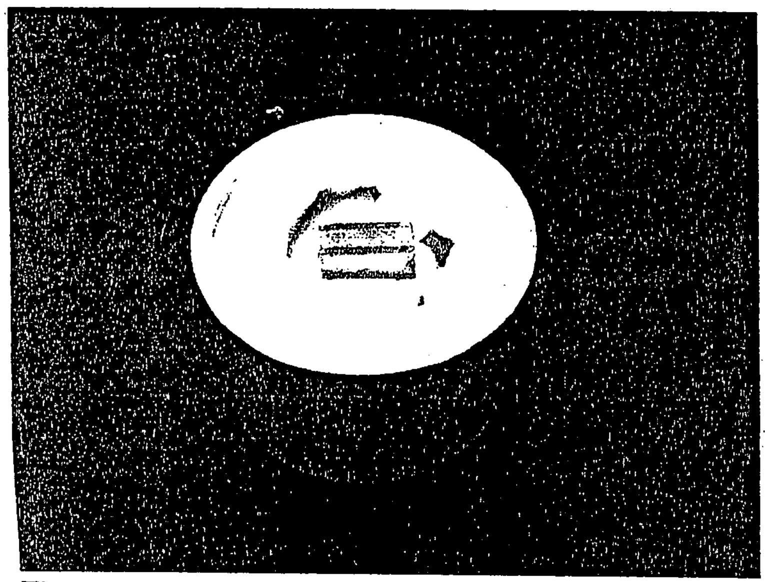

Figure 7 - A picture of the cut sample in the bottom portion of the test jig.

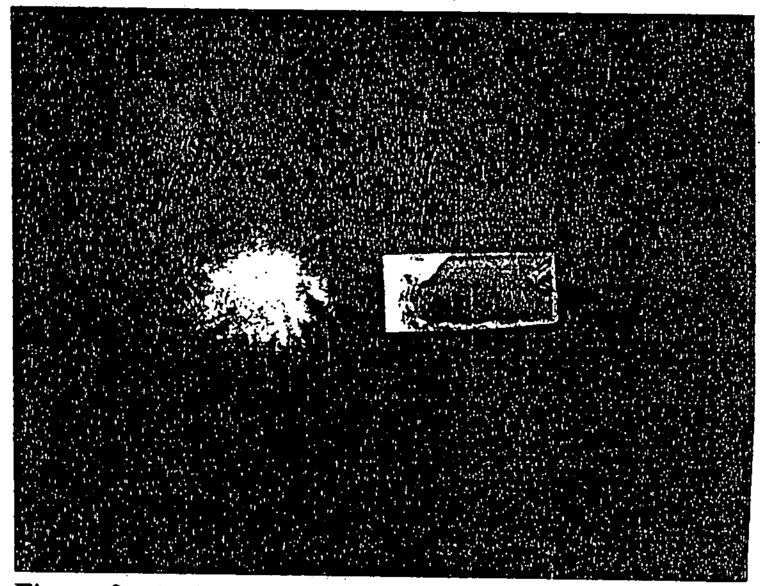

Figure 8 - A picture of the cut sample after testing and the associated loose material generated during the test.

Testing in Accordance of 1310A section 7.10 Structural Integrity

Customer ID	SwRI Lab System ID	Weight Before	Weight after test	Loose sample after test
01C0207-1	166635	115.9228 gm	115.6379 gm	0.2841 gm
01C0207-2	166636	368.43 gm	367.39 gm	1.0311 gm
01C0207-2 (cut)	166636 (2 7/8")	116.1162 gm	113.5908 gm	2.5252 gm

010003

Nevada Test Site: Hydrogeology and Potential Exposure Pathways For Lead in Glovebox Windows and Gloves

Kaiser-Hill Company, L.L.C.
November 27, 2001

The Nevada Test Site (NTS) is located in a geologically favorable environment for safe, long-term disposal of low-level radioactive wastes. The "Final Debris Rule" provides that debris can be reviewed on a case by case basis to determine whether its disposal poses a threat to human health or the environment, "taking into consideration such factors as site hydrogeology and potential exposure pathways, but excluding management practices[1]." The following discussion evaluates the limiting factors associated with the leachability of lead in glovebox windows and gloves that are disposed at the Nevada Test Site.

As a starting proposition, the lead in glovebox windows and gloves is not leachable to any significant degree. Dr. John W. Drexler[2] has rendered his expert opinion that the windows' surface area size and physical structure make significant leaching of lead highly unlikely in a disposal environment. Further, the unleaded outer panes of glass encapsulate the lead in the windows. Similarly, a durable elastomeric or polymeric material encapsulates the lead in gloves.

In addition, the hydrogeology of Nevada Test Site renders the leachability of lead even less significant. Finally, the potential pathways for human health or environmental exposure are quite limited. As a result, it is concluded that disposal of gloveboxes that contain leaded components do not pose a threat to human health or the environment, "taking into consideration such factors as site hydrogeology and potential exposure pathways" at the Nevada Test Site.

There are two potential human health or environmental exposure pathways from the disposal cells at the Nevada Test Site:

- ✓ Transmission of dissolved lead from the waste pile to the underlying groundwater; and,
- ✓ Transmission of lead into the immediately adjacent surface environment (to include surface soils and overlying atmosphere).

[1] Management controls are not relied upon in this site-specific risk analysis. Nevertheless, it bears noting that human access to NTS is limited rigorously by the Department of Energy.
[2] Laboratory Report, Dr. John W. Drexler, Laboratory for Environmental and Geological Studies, University of Colorado, August 14, 2001.

ND

Transmission of contamination to the underlying groundwater is not likely.

Less than four inches of rain falls per year in the arid, desert environment that is Nevada Test Site. Of this amount, most precipitation is subsequently re-evaporated, resulting in less than 0.25 inches of rainwater per year available for dissolution and potential transmission of lead into the subsurface environment.

The Department of Energy blankets its low-level waste disposal cells in a sixteen-foot thick cover of rock and cobble, where these materials function as evapotranspirative barriers to the passage of water. Evapotranspiration refers to the phenomenon whereby incident rainfall is either evaporated directly into the atmosphere or absorbed by surface plants, which then transpire the water as part of their life cycle. Desert surface plants are extremely efficient at scavenging water. Less than 0.1 inch of water per year is available to infiltrate the evapotranspirative barrier. In addition, the thickness of this barrier allows barrier flexibility and re-consolidation in the event of shifting or settlement of the subsurface, thus providing additional integrity to the cover.

Given the arid environment of the Nevada Test Site, it is not surprising that the nearest groundwater beneath the disposal site is at least 700 feet below the ground surface, and up to 1,200 feet below the surface in some areas. Studies by the Nevada Test Site have established that what rainwater does infiltrate takes more than a thousand years to reach this underlying aquifer. (Moreover, this aquifer is not potable and would, accordingly, not be anticipated as a drinking water source.)

Importantly, the infiltrating water does not retain the chemical balance it had when it initially fell, but rather, is chemically buffered by the host rock through which it must travel. First, geologic media exhibit a characteristic called Cation Exchange Capacity (CEC), which is the tendency for the material to sorb from adjacent waters dissolved cations such as lead. Second, geologic media that contain calcium or magnesium carbonate exert an additional attenuating factor, where lead precipitates from solution to form a lead carbonate, releasing calcium or magnesium into the solution.

Near surface dispersal of contamination is minimal.

The thickness and maintenance-free aspects of the sixteen foot evapotranspirative barrier not only minimizes passage of infiltrating rainwater, but effectively segregates the disposed waste from subsequent dispersal in the near surface environment. For example, it is not anticipated that processes such as erosion, burrowing animals, freeze-thaw cycles, etc. will affect the barrier's long term performance. Even if the amount of annual rainfall substantially increases, the cover surface and cobble sizes would be expected to inhibit cap erosion. Further, the cobble sizes are too heavy to allow the local mega-fauna

31

(such as desert mice) to burrow, and the thickness of the barrier also precludes micro-fauna (such as insects) from reaching the wastes.

In conclusion, just as the geologic environment at the Nevada Test Site is well suited for the effective, maintenance-free containment of radiological contamination, it is also well suited for the effective containment of non-radiological heavy metal contamination such as lead. Gloveboxes that contain leaded components do not pose a threat to human health or the environment, "taking into consideration such factors as site hydrogeology and potential exposure pathways" at the Nevada Test Site.